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14. ABSTRACT

Purpose: The study objective was to assess iron status indicators and the prevalence of iron deficiency (ID) and iron deficiency anemia (IDA) in both male and female military personnel deployed to Afghanistan.

Design: Observational Study

Methods: All participants completed a demographic data sheet providing information about their age, sex, length of deployment, home base zip code (for altitude determination), previous history of anemia, and length of time since last blood donation. Females completed a menstrual history questionnaire. Blood was collected for analysis (Hematocrit, hemoglobin, total saturation, ferritin, mean corpuscular volume, and serum transferrin receptor).

Sample: Participants included a convenience sample of 294 military personnel (149 men and 145 women) deployed to Bagram Air Base, Afghanistan that were deployed at least 3 months.

Analysis: A 3-variable model identified volunteers with ID or IDA. Participants were categorized as ID if they presented with >2 of the following 3 indicators of abnormal iron status: serum ferritin < 12 ng/mL, TS < 16%, or MCV < 80 fL. From this subgroup, IDA was categorized as those participants who met the criteria for ID and had a Hb concentration < 12 g/dL

Findings: Two males (1%) and 8 females (6%) were classified as iron deficient. Three iron deficient females (2%) met the criteria for IDA. Both female sex ($p = 0.05$) and a self-reported history of anemia ($p < 0.05$) were associated with diminished iron status. In female volunteers, menstruation affected iron status indicators, as Hb concentration and serum ferritin were higher in women reporting amenorrhea as compared to those without amenorrhea ($p < 0.05$). Correlation analyses indicated a relationship between iron status indicators and age; Hb concentration was negatively correlated ($r = -0.29$, $p < 0.05$) with age in male participants, and log serum ferritin values were positively correlated with age for both males ($r = 0.24$, $p < 0.05$) and females ($r = 0.21$, $p < 0.05$).

Implications for Military Nursing: In an effort to minimize performance decrements associated with IDA, nurses should target ID/IDA screening for these subgroups of military personnel. Identifying and treating personnel with ID/IDA before deployment will support a fit and ready force.

15. SUBJECT TERMS

iron deficiency, iron deficiency anemia, fit and ready force, military deployment

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TriService Nursing Research Program Final Report Cover Page

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Abstract

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Findings: Two males (1%) and 8 females (6%) were classified as iron deficient. Three iron deficient females (2%) met the criteria for IDA. Both female sex ($p = 0.05$) and a self-reported history of anemia ($p < 0.05$) were associated with diminished iron status. In female volunteers, menstruation affected iron status indicators, as Hb concentration and serum ferritin were higher in women reporting amenorrhea as compared to those without amenorrhea ($p < 0.05$). Correlation analyses indicated a relationship between iron status indicators and age; Hb concentration was negatively correlated ($r = -0.29$, $p < 0.05$) with age in male participants, and log serum ferritin values were positively correlated with age for both males ($r = 0.24$, $p < 0.05$) and females ($r = 0.21$, $p < 0.05$).

Implications for Military Nursing: In an effort to minimize performance decrements associated with IDA, nurses should target ID/IDA screening for these subgroups of military personnel. Identifying and treating personnel with ID/IDA before deployment will support a fit and ready force.

TSNRP Research Priorities that Study or Project Addresses**Primary Priority**

Force Health Protection:	<input checked="" type="checkbox"/> Fit and ready force <input type="checkbox"/> Deploy with and care for the warrior <input type="checkbox"/> Care for all entrusted to our care
Nursing Competencies and Practice:	<input type="checkbox"/> Patient outcomes <input type="checkbox"/> Quality and safety <input type="checkbox"/> Translate research into practice/evidence-based practice <input type="checkbox"/> Clinical excellence <input type="checkbox"/> Knowledge management <input type="checkbox"/> Education and training
Leadership, Ethics, and Mentoring:	<input type="checkbox"/> Health policy <input type="checkbox"/> Recruitment and retention <input type="checkbox"/> Preparing tomorrow's leaders <input type="checkbox"/> Care of the caregiver
Other:	<input type="checkbox"/>

Progress Towards Achievement of Specific Aims of the Study or Project

Findings related to each specific aim, research or study questions, and/or hypothesis: All specific aims and research questions have been answered and published: Wilson, C., McClung, J.P., Karl, J. & Brothers, M.D. (2011). Iron status of military personnel of deployed to Afghanistan. *Military Medicine*, 176. 1421-1425. (Appendix A)

The specific aims of this study are to determine:

- a. The iron status in a deployed sample at moderate altitude.
- b. The correlation between menstrual history and iron status.

Research Questions:

- a. What is the iron status in a deployed sample at moderate altitude?
- b. Is there a difference in the prevalence of iron deficiency and iron deficiency anemia between deployed men and women?
- c. Is there an increased prevalence of iron deficiency and iron deficiency anemia in women who have menstruation as compared to women who do not have menstruation?

Relationship of current findings to previous findings:

This study provided insight into the iron status of deployed personnel. Before the study was completed, researchers extrapolated that deployed personnel at moderate altitude may experience ID/IDA at the same prevalence as military personnel in training environments at moderate altitude (Wilson & Brothers, 2010). The incidence of ID was 13% in one group of women at the start of BCT, 33% in a second group of women at the end of BCT, and 10% in a group of women following permanent duty assignment for a period of at least 6 months (McClung, et al, 2006). A series of studies at U.S. Army BCT found that the prevalence of ID and IDA in soldiers at the start of BCT was similar to the corresponding demographic in the U.S. population, but increased immediately following the training course (McClung & Karl, et al, 2009). Among data collected at USAFA (altitude 2210 m), between a third and a half of both male and female recruits from sea level experienced ID within the first few months of military service at altitude (Brothers, 2010).

Our finding that 6% of female military personnel experienced ID during operational deployment is consistent with earlier reports that iron status may be improved following completion of initial military training.

Effect of problems or obstacles on the results: All serum samples were collected prior to receiving TSNRP funding. Therefore, there were no problems with data collection for the purpose of this report. The only issue was transporting the frozen specimens from the AOR to CONUS. The transport company lost its contract and there was a delay getting non-essential items transported back from the AOR. Further, the samples were left on a loading dock for a few hours before picked up. Luckily, the samples remained at the appropriate storage temperature.

Limitations: This study was limited in its use of a mixed convenience sample that provided a snapshot of one community within the deployed population, but did not fully assess all factors potentially affecting iron status (e.g., race and ethnicity, job duties, physical activities, iron intake through diet). This additional information would improve the ability to determine factors associated with poor iron status, such as heavy physical activity or the consumption of foods that either contain iron or inhibit iron absorption. A major strength of this study was its novelty. To the best of our knowledge, no other study has assessed iron status in military personnel during combat deployment.

Conclusion: The prevalence of ID and IDA in military personnel deployed to Afghanistan does not appear to be markedly greater than that reported in the U.S. population. However, some personnel remain at greater risk, such as, those with a history of anemia and menstruant women. In an effort to minimize, the known performance decrements associated with IDA, health care providers and nurses should target ID/IDA screening assessments for these subgroups of military personnel. Identifying and treating personnel with ID and IDA before deployment will support a fit and ready force.

Significance of Study or Project Results to Military Nursing

According to training literature of new recruits or accessions, the rate of ID and IDA was a significant health risk to these military members. It was surmised that the rate of ID/IDA in a training environment was transferred to a deployed population because the deployed prevalence rate was unknown. A major strength of this study was its novelty because no other study has assessed iron status in military personnel during combat deployment. This study contributed to narrowing a scientific gap on the iron status of deployed personnel, a known sex difference in health care needs. The outcomes of this study inform nurses and health care professionals that are involved in the deployment preparation of military members. They should target assessing those members at highest risk for developing ID/IDA while deployed (history of anemia, female sex, regular menstruation) as determined by the results of this study.

Since the conclusion of this study, the PI has drafted a clinical practice guideline for ID/IDA screening in military trainees and deploying military members at greatest risk. The CPG will provide guidance to nurses and primary care providers.

Future studies assessing iron status should consider race and ethnicity, military specialty, duty requirements affecting physical activity, and dietary intake. If altitude acclimatization is a factor, iron and other hematological values should be assessed within the first 1 to 3 months of arrival, when an increased risk of ID and IDA would be expected because of the increased iron demand for elevated erythropoiesis. Contributors to poor iron status should be assessed in the deployed setting; many military personnel face potentially limited dietary options and increased physical activity while deployed. Because ID and IDA can affect cognitive or physical performance during operational deployment, at-risk individuals (i.e., menstruant women and those with a history of anemia) provide a target population for intervention for the prevention of ID/IDA.

Changes in Clinical Practice, Leadership, Management, Education, Policy, and/or Military Doctrine that Resulted from Study or Project

The outcomes of this study were integral to military trainee and military readiness health care providers in preparing both populations for intense training and military operations. This study was included in a military iron status-working group that decided to provide prenatal vitamins to military women during intensive training and operations, based on these study results. This intervention is still be evaluated in the trainee health population working group at Lackland AFB, TX.

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- Wilson C, McClung JP, Karl, JP, Brothers MD: Iron status of military personnel deployed to Afghanistan. *Mil Med* 2011; 176(12): 1421-1425.

Summary of Dissemination

Type of Dissemination	Citation	Date and Source of Approval for Public Release
Publications	Wilson C, McClung JP, Karl, JP, Brothers MD: Iron status of military personnel deployed to Afghanistan. Mil Med 2011; 176(12): 1421-142	20110423 PAO Clearance
Published Abstracts	None.	
Podium Presentations	<p>Wilson, McClung, Karl, and Brothers, Iron Status of Deployed Military Members, American Academy of Ambulatory Care Nursing, San Antonio, TX May 2011.</p> <p>Wilson, McClung, Karl, and Brothers, Iron Status of Deployed Military Members, Pacific Institute of Nursing conference, Honolulu, HI Mar 2011</p> <p>Wilson, McClung, Karl, and Brothers, Iron Status of Deployed Military Members, 2010 Air Force Medical Symposium, Washington DC, Aug 2010</p>	<p>20110524 PAO Clearance</p> <p>20100526 PAO Clearance</p> <p>20100526 PAO Clearance</p>

Poster Presentations	Wilson, McClung, Karl, and Brothers, Iron Status of Deployed Military Members, 2010 Karen Reider Nursing Research Poster Session, Association of Military Surgeons in Uniformed Services, Phoenix, AZ, Nov 2010	20101122 PAO Clearance
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Reportable Outcomes	
Reportable Outcome	Detailed Description
Applied for Patent	none
Issued a Patent	none
Developed a cell line	none
Developed a tissue or serum repository	none
Developed a data registry	none

Recruitment and Retention Table

Recruitment and Retention Aspect	Number
Subjects Projected in Grant Application	400
Subjects Available	
Subjects Contacted or Reached by Approved Recruitment Method	
Subjects Screened	none
Subjects Ineligible	
Subjects Refused	
Human Subjects Consented	294
Subjects Who Withdrew	0
Subjects Who Completed Study	294
Subjects With Complete Data	
Subjects with Incomplete Data	

Summary regarding recruitment and retention: *All the subjects were recruited and completed the study data collection procedures before this grant was awarded.

Demographic Characteristics of the Sample

Characteristic	
Age (yrs)	34±10
Women, n (%)	145 (49%)
Race	unknown
White, n (%)	()
Black, n (%)	()
Hispanic or Latino, n (%)	()
Native Hawaiian or other Pacific Islander, n (%)	()
Asian, n (%)	()
Other, n (%)	()
Military Service or Civilian	unknown
Air Force, n (%)	()
Army, n (%)	()
Marine, n (%)	()
Navy, n (%)	()
Civilian, n (%)	()
Service Component	unknown
Active Duty, n (%)	()
Reserve, n (%)	()
National Guard, n (%)	()
Retired Military, n (%)	()
Prior Military but not Retired, n (%)	()
Military Dependent, n (%)	()
Civilian, n (%)	()